AMERICAN ELECTRO-PLATERS SOCIETY

(An Educational Society)

Chartered 1909

MONTHLY REVIEW

AUGUST, 1915

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I shall pass through this world but once. Any good thing, therefore, that I can do, or any kindness that I can show to any human being, let me do it now. Let me neither defer nor neglect it, for I shall not pass this way again.—*Amiel.*

MONTHLY REVIEW

American Electro-Platers' Society

(An Educational Society)

Vol. 2 AUGUST No. 3

EDITORIALS

This issue brings before the members of the A. E. S., a new Editor, Mr. H. J. Richards of St. Louis Branch, who has shown his willingness to be of service to our society when the call comes. At the recent convention, many members of the Supreme Society declined the honor, which entailed much time and labor and brought in return some questionable criticism, so it remained for someone to show the courage and greatness of their makeup, so our records prove that the person to meet the emergency at that time was no less than our esteemed Ex-President, Col. J. H. Hansjosten, who said "It can't be done," but changed his mind quickly, and it was done. While we wish the Colonel great success in his new position as a "scout" yet we regret losing his personality from the active membership and as Editor of Review.

Mr. Richards, while not being honored officially by a title, has been referred to as "Commodore'" because of his willingness to take the lead in any venture which may be a source of pleasure and benefit to his fellow members, even though the way be rough and obstacles many. Members that attended the Dayton Convention need no introduction to him, so I wish to introduce our present Editor to others as a man willing to serve to the best of his ability, the office he has been asked to accept. His desire has always been to see the Review improve, yet realizes that the Editor without assistance from the members cannot accomplish the best. He wants your co-operation. The writer requested the privilege of this editorial in appreciation of Mr. Richards' immediate acceptance when this emergency call from our Supreme President came through him.

H. H. WILLIAMS,
Supreme 1st Vice-President.

Branch secretaries note new editor's address and forward reports and papers promptly.

LET'S CAST AWAY IMAGINARY MYSTERIES.

READ BY JOS. BIRBAUM.

De Ruolz was the first, who in the year 1842, succeeded in depositing an alloy of metal electrolytically ever since then it has always been maintained that owing to the mixture of the component metals of brass, i. e., copper and zinc, that the depositing of brass is the most troublesome, most difficult feat in electroplating, this is partly correct—but why?

CONDITIONS AND ALLOY.

Taking silver as a basis for electrical conductivity at O° C silver having the lowest resistance it registers therefore as our standard a conductivity of 100.00; Copper 99.90, zinc 29.00.

But "Lady Difficult" is not satisfied with this large variation of conduction between copper and zinc, she gives us another factor to contend with, this is the unequal proportions of these metals needed to produce a clear yellow brass—copper 65-70 parts, zinc 35-30 parts, taking these two factors in consideration, it will be seen at once why brass plating has its perplexing problems.

Years ago I placed this question before me. If it is more difficult to control and merge two metals properly into one electrolytic deposit than to deposit one, why then use three. This third one isin the form of brightener in such small proportions, that should the correct amount be overstepped, not even a current regulation will be able to give immediate relief, i. e., the desired color of brass, and instead of a yellow brass we have a grey or green. Again I am compelled to ask, why use Arsenious Acid ($As_2 O_3$) when there are other methods at the disposal of the plater to accomplish the same effect.

So called mechanical brass baths, differ from still baths only in solution density, and higher metallic content. The alloy of the metals should be the same, copper 65-70; zinc 35-30 parts; although as I demonstrated a yellow brass can be produced with the metals practically reversed from above order, it is not advisable nor practical, hence it shall not be considered at this time, the main aim of this paper is to establish the joint deposition of copper and zinc in the form of brass on a basis of simplicity. The plater must understand why the different ingredients are added to the plating solution and their action therein.

SOLUTION DENSITY.

What the chlorides, carbonates and cyanides of metals, copper, zinc, tin, nickel, silver, gold, etc., are, and how they are made, is known to you, therefore we'll get down to the actual brass solution.

In as much as the platers have up until now generally been

accustomed to use the carbonates of metals instead of the cyanides and many will undoubtly continue to do so for some time, I shall use the carbonates as a basis.

In order to accomplish a rapid heavy deposit in nearly the same period as in the still solution showing a Hydrometer test of 12 Be′ or a metal content of 2.76 ounces per gallon, the mechanical solution ought to register 16 Be′ with a metal content of 3.68 ounces pergallon. At this result we arrive by dissolving 5 ounces of copper carbonate (Cu Co_3) and 4 ounces of zinc carbonate (Zn Co_3) in 19 ounces of Potassium Cyanide (K C N) 98/99% in one gallon of water and since the metallic content of reliable Copper carbonate is 55% of its weight that of Zinc carbonate 30% we arrive approximately at a metallic content of 3.68 ounces per gallon, which divides itself into the required 2 to 1 proportion of yellow brass, metallic copper 2.48 ounces, metallic zinc 1.20 ounces.

Chemical Changes.

And so by this process of dissolving the carbonate of the metals with a Cyanide Solution we are converting the carbonate of Copper (Cu Co_3) and Carbonate of Zinc (Zn Co_3) into the Cyanides or double Cyanides of these metals (Cu K CN)+Zn KCN under a slight loss of Cyanogen, and a conversion of a fraction of the potassium cyanide mixture into potassium and sodium hydrate (K O H and Na O H) this loss of C N, the forming of caustic potash and soda, and the subsequential decompositions into formates, HCOOK (HCOONa) becomes more and more pronounced with the exposal of the solution to the air and electric current. We have then not only the 45% of inert matter of the Cu CO_3 and the 70% of the Zn CO_3 to contend with, but we are forming other chemicals which originally were not added to the bath, to overcome these partly, as we are not able to avoid them, will be seen later.

Formulas.

There are many, too many, formulas for brass baths in existence which only tend to confuse the plater who has run up against a snag, and seek a remedy. He ought not use what he is not familiar with and should make the plating bath as simple as possible.

Besides the two necessary metals and cyanide, Arseninous Acid (As_2 O_3) Sodium Bisulphite (Na HSO_3) Sodium Sulphate (Na SO_3) Sodium Carbonate (Na_2 CO_3) Sodium Bicarbonate (Na HCO_3) Ammonium Carbonate (N H_4CO) Caustic Potash (KOH) Caustic Soda (NaOH) etc., etc., too numerous to mention, are used as conductors and brighteners, and some to cause trouble. A good working, reliable plating bath for brass consists of

1. Copper carbonate, 3⅛ lbs., 55% Metallic.
   Zinc carbonate, 2½ lbs., 30% Metallic.
   Potassium cyanide mixture, 11⅞ lbs., 98/99%.
   Sodium bisulphite, 1½ lbs.
   Sodium carbonate, ½ lb.
   Water, 10 gallons, Aqua ammonia, 1 ounce.

1a. Dissolve the Cyanide in 6 gallons of water.

2a. Dissolve the Carbonate of soda, slowly, add the bisulphite of soda, then the Metal carbonates, pour under agitation 2a into 1a, work through with current, then add ammonia.

If Cyanides of Metals are used and a metallic percentage equaling formula 1 is wanted use

2. Copper Cyanide, 2⅕ lbs., 70% Metallic.
Zinc Cyanide, 1⅜ lbs., 56% Metallic.
Potassium Cyanide, 5 lbs., 98/99%.
Sodium Bisulphite, 1 lb.
Sodium Carbonate, ½ lb.
Water, 10 gallons, Aqua Ammonia, 1 ounce.

Prepare in the same manner as formula 1, if preferred the preparations can be made into copper bath first and then the zinc added to suit. Add sufficient free Cyanide to both formulas to suit your particular requirements.

A larger amount of sodium carbonate is permissible in formula 2 without impairing the brightness of the deposit, since it contains less inert matter.

A low density of solution is the result of this formula with the same metallic content of formula 1, containing less or no impurities it registers a lower Be′ test than carbonate solutions and so I'll leave it to the plater to do a little figuring in comparison.

It must be appreciated that both formulas are for bright plating, also that the metals in a pure and purely metallic Cyanide solution would deposit in the bright natural grain, however this is not practical on a large scale, hence we add other ingredients to assist the metals, some of which help to brighten the deposit, while others dull it, as also will the decomposed potassium Cyanide in the solution. After it is run for a long time, the solution thickens up, becomes sluggish, shows a general infection of the poor white trash disease, the hook worm, it won't deposit lively, and bright enough, the plating might assume a muddy appearance, be red, white or both, which in two cases causes the plater to feel blue, thereby creating a patriotic but not looked for combinations.

Assuming we have run a bath extensively in order to keep the metallic percentage at the required amount we added from the time new metals in Cyanide a test proves sufficient metal as well as free cyanide, still we're having some of the above named troubles.

What are we going to do, use Arsenious Acid?

True enough arsenious acid sets a slight discoloration right momentarily, but is at best only a temporary relief for such irregularities.

Arsenious acid has some good properties, but more bad ones, it is a brittle, very lustrous metal, and imparts this luster partly to the principal metals of the brass as well as its brittleness, it causes the

plating to raise, blister readily and is a factor of coated anodes. As a brightener, it is used in such small amounts that a hard working bath must be doped up almost daily with a new dose thereof, thereby running all kinds of chances. A brass bath containing arsenious acid does not produce the yellow color of a good alloy of brass 67-33 without arsenic.

Arsenious acid dissolved in Cyanide gives off strong fumes of Prussic Acid (HCN) which has a clarifying effect on old solution, however,there are other recourses to accomplish this and so I cannot recommend the use of arsenious acid.

Potassium Cyanide.

To delve into the properties and manufacture of potassium Cyanide (KCN) and sodium Cyanide (NaCN) is of course impossible in this paper, it would consume pages and pages to do so, hence we can only do justice to this dominating solvent of the Electro-plating Industry, by being content with a few explanatory remarks.

Pure Potassium Cyanide contains 40% Cyanogen.

Pure Sodium Cyanide contains 53% Cyanogen.

The Potassium cyanide as it is generally used by the platers contains from 15/25% sodium, a mixture of these two cyanides containing 15% sodium assays at 99%.

Pure Cyanide is produced in many ways.

By fusing potassium carbonate with charcoal in a porcelain tube and passing nitrogen gas through it.

By fusing ferrocyanide with potassium carbonate and reducing part of the cyanate to cyanide with the charcoal, or the cyanide can be reduced with metallic zinc, or extracted with carbon disulphite.

By passing dry ammonia gas through a fused mixture of potassium carbonate and carbon.

By passing ammonia gas through a fusion of sodium cyanide, metallic zinc and charcoal.

Several more methods could be mentioned but these must suffice, they plainly show the important part charcoal plays in the production of the cyanides, this perhaps brought the use of charcoal for clarifying old cyanide solutions in vogue, some years ago, I know of platers who would spread charcoal over their solution every Saturday as regularly as a clock and skim it off Monday morning, claiming to receive beneficial action thereby. I can't give this any credence and doubt that charcoal applied in this manner would have a reducing effect on the hydrates or formates in the solution. However it is my practice not to condemn anything to which I have not given a fair, extensive experiment and trial. Potassium Cyanide as set forth under chemical changes, is very decomposable by the electric current and the carbon dioxide (CO_2) and moisture (H_2O) in the air. This carbonic acid and current have the power to decompose the cyanide into formates and ammonia and they, then are

useless as solvents of the metal. Still solutions are of course not as readily attacked by these decomposing agents as agitated or barrel plating solutions where a higher current density is used, nevertheless these changes are taking place and the time will arrive where they become obnoxious in all cyanide solutions. To overcome or prevent this, the knowing Artisan resorts to the use of reducing agents, be they now Barium Cyanide ($Ba\ CN_2$) Calcium Cyanide ($Ca\ CN_2$) Carbon Disulphite ($C\ S_2$) or Hydrocyanic Acid ($H\ C\ N$) for Silver solution, or Sodium Hyposulphite ($Na_2\ S_2\ O_3$) for Cyan-copper solutions, and Sulphurious Acid, ($H\ S\ O_3$) or Sodium Bisulphite ($Na\ HSO_3$) or Arsenious Acid ($As_2\ O_3$) for brass solution is immaterial. They act as reducers of the formates and thereby bring out a smoother or bright deposit.

Sodium Bisulphite ($Na\ H\ SO_3$)

This acid salt is formed by saturating sodium carbonate solution with sulphur dioxide. $Na_2\ CO_3+H_2\ O+2\ SO_2=2\ NaHSO_4+CO_2$.

On exposure to the air it loses Sulphurious Acid and changes to Sodium sulphate ($Na\ SO_4$) it is a strong reducing agent with very little effect on the zinc in the solution but readily combines with the cupric copper and cyanide, thereby forming cuprous cyanide, cuprous copper disolves in cyanide quicker than cupric copper and without loss of cyanogen. If slight excesses of Sodium Bisculphite are used very lustrous deposits will be received.

As was stated previous, the carbonic acid of the air and the electric current gradually decompose part of the KCN; if now, when this condition becomes noticeable by the appearance of the work, ammonia and then Bisulphite of Soda is introduced into the solution, part of these obnoxious formates are under escape of Carbon dioxide (CO_2) converted into cyanides, and sodium sulphate thereby clearing up the solutions and brightening the deposit.

In general $Na\ HSO_3$ is accused of destroying the free Cyanide in the solution, perhaps this impression is created, because immediately after an introduction of $Na\ HSO_3$ the anodes become coated over with a metallic scum, this is caused through the reduction of the Hydrates and carbonates by the Sodium Bisulphite, but after reaction is complete, the solution cleared up and the rapid coating of anodes disappears. A pure potassium cyanide is not affected by sodium bisulphite but as soon as hydrates or carbonates are present a violent effervescence takes place, furthermore these hydrates and carbonates are strong conductors. By introducing sodium bisulphite the strength of these conductors are reduced, forming a stronger resistance and so this also might contribute to the belief that the KCN is destroyed.

You are well aware of the beneficial action sodium hyposulphite has in a cyan-copper bath, zinc being present in the brass sodium hyposulphite cannot be restored to, but sodium bisulphite takes its place with equal results when properly applied.

Some carbonates must be present to facilitate proper deposition,

to assist in transmitting the ions and zinc, but they retard a bright deposit, and if this is what we seek we must reduce them to the amount where they are beneficial, not harmful.

Sodium Carbonate. $Na_2 CO_3$.

Next to Potassium Cyanide one of the most used chemicals in the plating room is made by the Le Blanc process by treating sodium Chloride with Sulphuric Acid thereby converting Sodium Chloride into Sodium Sulphate.

1. $2\ Na\ Cl + H_2\ SO_4 = Na_2\ SO_4 = 2HCl$.

The Sodium Sulphate thus obtained is heated with charcoal which reduces the sulphate to sulphite.

2. $Na_2\ SO_4 + 2C = Na_2\ S + 2\ C\ O_2$.

The Sodium Sulphide is heated with calcium carbonate when Sodium carbonate and calcium sulphide is formed.

3. $Na_2\ S + Ca\ CO_3 = C\ O_3\ Ca\ S$.

This mass is then treated with water which dissolves the Sodium carbonate, the sulphite of calcium being insoluble.

In the Solvay or Ammonia Soda process the $Na_2\ CO_3$ is made by passing Carbon dioxide into a strong solution of sodium chloride which forms chloride of ammonia and precipitates bicarbonate of soda, the bicarbonate is then heated forming the carbonate.

$$Na\ Cl + HNH_4\ CO_3\ H\ Na\ CO_3 + NH_4\ Cl.$$

Reaction when heating the bicarbonate of soda

$$2\ H\ Na\ CO_3 : : Na_2\ C\ O_3\ C\ O_2\ H_2\ O.$$

The amounts of Sodium carbonate recommended per 10 gallons of brass solution cover a large variation, I can only see harm when large amounts are resorted to. Sodium carbonate acts intensely to bring out the zinc, if now per chance a larger quantity of zinc is in the solution than ordinarily required, a burning of the deposit will result under the same current density, as of a solution containing less $Na_2\ C\ O_3$.

Furthermore large amounts have a tendency to soften and dull the deposit, and since we are continually striving to overcome dull deposits in nearly all plating solutions, we can in the brass bath help our other means along very nicely by reducing the sodium carbonate to the lowest practical amount, which after years of close study I have found to be the proportions given in the two formulas, however the rapidity of the deposition suffers if the amount is reduced too much.

The foregoing shall by no means serve as a general condemnation of the sodium carbonate for brass baths, but of its excessive use, $Na_2\ C\ O_3$ is very beneficial if applied properly, if for instance the deposit is dark, and its action is favorable as a conductor and on the zinc $Na_2\ CO_3$ it immediately lightens the color, providing of

course the solution contains neither an excess of cyanide nor an excess portion of copper.

When the plating appears a red brown this also will disappear after a correcting addition of $Na_2 CO_3$, this condition might arise if a reducing agent was used too freely. The Na CO rectifies this trouble however this brown must not be confused by the plater with the brown of a burnt deposit insufficient cyanide or excess ammonia, it takes experience to distinguish all these little indicators of trouble in sight, that's why electro-plating is just a little bit more than mere manual labor.

AQUA AMMONIA. ($N H_4 O H$).

Is erroneously resorted to as a brightener (to produce a brilliant deposit) its action in reality is to give a lighter color to the deposit; this lightening up is slightly noticeable even after an addition of potassium cyanide, the color, after additions of cyanide or carbonates goes more into a whitish brass, whereas $Na H_4 O H$ produces a beautiful yellow colors.

Carbonates of copper and zinc are slightly soluble in Aqua Ammonia and the $N H_4 O H$ is therefore rendering assistance when cyanide is wanting in the solutions, although free cyanide must ultimately be resorted to, additions of $N H_4 O H$ keep brass solution more constant in at least this direction, since ammonia ($N H_3$) is liberated under decomposition of potassium cyanide.

Should the solutions adhering to the work from dark-brown spots if not rinsed off immediately, this is usually an indication of a lack of free cyanide and not an excess of Ammonia although in reality it is the Ammonia in combination with possible undissolved Metals which causes this oxidizing appearance. A sufficient amount of free cyanide rectifies this trouble. To use an excess of Aqua Ammonia is for an experienced plater an unreasonable act, but should it occur it can easily be expelled from the bath by warming it up and there will be more dark brown (not taste) the morning after.

RESUME.

Metals do not combine in a chemical solution, if an alloy of metals in a chemical solution would be possible depositions of brass as well as green and roman gold, would be a matter of simplicity.

You are experienced Electro-platers, hence, I am not trying to teach you your profession, or some new tricks, but merely explain a few imaginary mysteries. All other plating solutions ought to be taken up in a similar manner, I shall gladly lend my assistance to do so.

The days of the cockroach plater, who keeps his employer and fellow workers in the dark because he lives in the dark himself are passing and passing fast.

Plating is an art requiring experience, skill and gray matter.

The A. E. S. is for education, absorb its spirit and you'll have reasons to be proud of yourself.

JOSEPH BIRBAUM,
Milwaukee.

SOME EXPERIMENTS WITH GRAIN OR SHOT NICKEL ANODES.

About two years ago experiments were started in the plating department of the The National Cash Register Company to see if shot or grain nickel could be used for anodes purposes, and if so, their relative efficiency compared with cast nickel anodes of standard size and shapes.

A container was made of maple, with sheets of perforated celluloid or bakelite in front and back, with cast nickel bars supported by a cast nickel rod for electrodes to carry current to the grain nickel, and the grain nickel filled in and around the bars. After being in use for two or more months and the nickel being found to be freely soluble under the action of the current, enough grain anodes were made up to fit up an entire tank and comparisons were made between the grain and cast anodes.

The electrolytes used were our standard nickel solution, made up as follows: dbl salts, 10 ozs.; single salts, 3 ozs.; boracic acid, 1 oz.; water, 1 gallon. This gave a metal content of approximately dbl. salt, 1.507 ozs.; single salt, 6 ozs.; total metal 2.107 ozs. per gallon. Density 8 Be'.

Two solutions were made up new so that no advantage or disadvantage would affect the anode showing and each solution contained 400 gallons. One of these solutions was fitted up with cast anodes of the oval type and used for comparison while the other was fitted up with the grain nickel anodes. The following points were selected for determination: Solubility of anodes; rate of deposition; difference in conductivity; difference of resistance; anode efficiency. Each solution was equipped with rheostat, voltmeter and amperemeter and an amperehour meter was used to weigh the amount of metal deposited and in each trial the amperehour meters figures were checked by the average amperes used, determined by readings of the amperemeter each minute during the runs. In all cases the figures checked very closely, the difference being due to the slight variations between readings. These trials were made on regular company product, the exposed cathode surface being the same for each comparative run and the same voltage, 1.75 volts for brass and bronze and 2 volts for iron and steel, maintained during the run.

The cast anodes were approximately 18" long, 4" wide and 2¼" thick. Total weight of anodes to the tank 1448 lbs. The weight of the grain nickel anodes averaged 28 lbs. each, a total of 1800 lbs. per tank.

During the year while tests were made the solutions were analyzed frequently and salts containing .23 oz. metal per gallon were added to the cast anode solution to maintain the original metal content, while nothing but water was added to the grain nickel solution, which graduallyincreased in metal until the analysis showed 2.94 oz. metallic nickel per gallon.

The amperehour meter records showed an increase of 5% more metal deposited by the grain nickel solution at the starting up of the experiments and as the metal content of the grain anode solution increased a relative increase in the amount of metal deposited was shown until at the time experiments were concluded the metal in solution had increased to 2.94 oz. per gal. and the percent of increase of deposit over the cast anode solution was 28%.

That this increase in solution efficiency is wholly due to the greater anode efficiency of the grain nickel anode is shown by the fact that whenever the grain anodes were taken out of the solution and cast anodes substituted the amperage commenced to drop with a consequent smaller amount of metal deposited to the run. The results of the experiments would indicate that the use of grain nickel for anode purposes is practical and economical, giving a greater anode efficiency than cast anodes, probably due to the larger number of points of contact in the grain nickel anode and the greater solubility of the grain anode, probably due to the same reason; lower cost of upkeep of the solution, no metal in the form of salts being added since it was made up; lower cost of anodes, the casting costs being removed; a purer anode, the grain nickel running 99.50% pure; greater output per tank on account of the more rapid deposition resulting in reduction in size of plant; saving of nickel from cast anodes, estimated at from 10 to 15% and the decreased investment through smaller amount of weight in nickel for anodes to give desired results.

W. FRAINE,
Dayton Branch.

ADVICE ON NICKEL SOLUTIONS.

Don't keep your solution to dense,
And to have it too weak shows no sense,
For crystallization will show it needs water,
And when it's too weak you've put more than you ought 'ter,
This steer we just think is immense.
And too much free acid is bad,
And alkali tendencies sad;
Don't have it too hot and don't keep it too cold
But keep it all right, just the way you've been told,
Or you surely will wish that you had.
Now I hope this advice will be took,
'Cause I find it in every book,
Don't use too much voltage, but just use enough,
Have your work polished smooth, it's no good if it's rough,
These ionize theories surely are tough,
And once again science is shook.

—From Our Laboratory.

SINGLE NICKEL SALT SOLUTIONS AND RESULTS I GET.

This interesting and up-to-date subject was suggested to the writer as topic for a paper to be read on this occasion. Single Nickel Salt Solution will be the theme and any results mentioned will be the results any plater gets who uses this solution.

Results are what the management wants when goods are sent to the plating room, marked "rush." If the plater is handicapped by lack of floor space, he tries to crowd the work through by depositing the nickel faster. With a double nickel ammonia sulphate solution, the results are a dark and brittle deposit, inclined to flake off.

The great drawback to a nickel ammonia sulphate solution is its poor conductivity and slowness of working, yet while this simple solution yields very good results there is no doubt that certain additions and modifications of this solution can be made which result in improving the deposit and the working of the bath.

Twelve ounces of nickel ammonia sulphate are all that one gallon of water will hold in solution at room temperature. A solution made after this formula will contain 1.77 oz. of metallic nickel per gallon of solution, if more double salts are dissolved in hot water and added to the solution, it will crystallize out, and an excess of ammonium sulphate will cause nickel ammonium salt to be precipitated out of the solution.

The disadvantage of this solution has caused investigation to find a substitute for double salts as a basis for nickel baths. Of recent years this has been increasingly successful and many platers have been using nickel sulphate solutions because of the higher degree of solubility of this salt. At room temperature, six parts of nickel ammonium sulphate will dissolve in one hundred parts of water, at the same temperature forty parts of nickel sulphate will dissolve in one hundred parts of water. These figures reveal the greatly superior solubility of nickel sulphate over nickel ammonium sulphate and at the same time it must be borne in mind that the percentage of nickel is greater in nickel sulphate.

Nickel sulphate can only be used in combination with a conducting salt for a plating solution, and a great many patented nickel salts sold under trade names are compounds of nickel sulphate and conducting salt, usually sulphates and chlorides of the alkaline earth metals.

This combination will give a solution rich in metal and good conductivity. With a high metal content, a much greater current density can be maintained and if a chloride conducting salt is used a nickel anode of a high percentage of purity can be successfully dissolved resulting in a much cleaner solution.

The theory is that all the ions in solution help to conduct the current, but only those ions figure in the deposition which are

separated by the least expenditures of energy so long as a sufficient number of these ions are present at the electrode.

It is obvious then, that if the solution around the cathode becomes impoverished through electrolysis, hydrogen will be separated by the current to the detriment of the deposit.

Under normal conditions of electrolysis continued deposition of metal from a solution is made possible by the migration of the ions, the positive ions migrating to the cathode and the negative ion to the anode. The natural rate of migration is very slow; Lodge found, for example, that the rate of migration of hydrogen ions—the swiftest known—is 1.15 centimeters per minute, less than one-half an inch.

The tendency during electrolysis is therefore, for the solution around the anode to increase in concentration and settle toward the bottom of the tank and the solution around the cathode to become impoverished and arise toward the surface of the bath.

Now, it will be readily understood that a solution rich in metal will considerably overcome this tendency of unequal concentration and also maintain the conductivity with the result that a greater current density can be used which of course means more rapid plating.

With nickel sulphate solution and a chloride conducting salt, nickel anodes of 96 to 98% purity have been successfully dissolved.

It is a fact that anode metal is more easily dissolved when the electrolyte contains a salt that furnishes an ion which forms an easily soluble salt with the anode metal. Nickel chloride is a more soluble salt than nickel sulphate, and in a solution of nickel sulphate containing sodium chloride, a nickel anode can be subjected to a large current density without passivity setting in.

Passivity is explained by Le Blanc as being caused by slow rate of ionization of the anode metal, the equation is Ni+2=Ni. It is read, "nickel in metallic state plus two charges of positive electricity will form nickel in the ionic state." To bring about this slow reaction an excess anode polarization is necessary, the anode then becomes passive and oxygen is evolved.

The electrolytic potential of a metal depends in a measure, upon its mode of preparation and its previous themal and mechanical treatment. Nickel anodes prepared in different ways will dissolve with different potentials in the same electrolyte and at the same current density. Cast nickel anodes of uneven structure will contain different mixtures of nickel which will dissolve at different potentials, for this reason it will yield large proportions of undissolved slimes.

The passivity of nickel decreases in the presence of chlorine or hydrogen ions. For this reason, platers sometimes make frequent small additions of sulphuric acid to the nickel bath to help dissolve the anode and act as a brightener. It is done at the expense of the

cathode efficiency and the slower rate of deposition yielding a brighter deposit.

The dissociation voltage of hydrogen is very near to that of nickel. For this reason nickel cannot be deposited out of an acid solution, hence the hydrogen concentration must be kept down or the current efficiency of the nickel deposition will be low. Much evolution of hydrogen around the cathode in a nickel bath denotes a low current efficiency.

Recent tests to learn the anode efficiency of a nickel sulphate solution containing sodium chloride gave the following results:

The solution contained 24 oz. nickel sulphate, one and one-half oz. boracic acid, one-half oz. sodium chloride. The anode surface equalled two times the area of the cathode. The anode and cathode were carefully weighed before and after plating, anode showed an efficiency of 99.06%, the anode surface was decreased to one and one-fourth times the cathode area and another test showed the anode efficiency to be 97.4%. The amount of sodium chloride in the bath was then doubled and a careful test showed that the efficiency of the anode had increased to 98.6%. These results show the importance of maintaining sufficient anode surface and the value of sodium chloride as a conducting salt.

The figures show the relative results under different conditions and not the actual anode efficiency in keeping up the metal content of the solution. The undissolved metal lost in the solution would lower it somewhat. However, this is a small amout when high grade anodes are used. In actual everyday work one cannot hope to attain results so near perfection as those found in laboratory experiments, yet it was a good showing because a high current density was used with anodes of 96 to 98% pure nickel.

The same solution was run in series with a copper coulombmeter to learn the current efficiency. At 76 degrees Fahrenheit and with a current density of twenty-five amperes per square foot cathode surface, using a rotating cathode resulted in a current efficiency of 96.2 to 96.7%. The solution was heated to 110 degrees Fahrenheit, the increased conductivity caused 30.9 amperes per square foot to flow through the same outside resistance and after a three hour run the cathodes were weighed showing a current efficiency of 96.6%. These results show that plating with rotating cathode or a hot nickel solution does not cause a large evolution of hydrogen at the cathode and a low current efficiency. These tests were carried out with 96% to 98% pure nickel anodes and during electrolysis the bath was kept neutral with carbonate of nickel.

Working at room temperature with a nickel bath of low concentration, it is difficult to get more than just a thin layer of nickel plating. Low temperature high current density, anodes and solution containing iron all favor an irregular deposition of iron and nickel and a flaking of the deposit.

Working at higher temperature with anodes and solution free from iron, there is no difficulty in getting adherent heavy deposits even at high current densities. A solution which is in use every day the workings of which will be described later, was built up of 24 oz. nickel sulphate, 1½ oz. boracic acid, ½ oz. sodium chloride, 1 oz. nickel carbonate. Using it as a still solution at 90 degrees F., a current of 15 amperes per square foot, flowing for fifteen minutes gave a good soft deposit free from pits. With cathode rotating and solution 90 degrees F., 30 amperes per square foot can be used, or with solution 100 to 110 degrees F. an exceedingly heavy plate can be deposited with a current density of 45 to 50 amperes per square foot.

If a high metal content in a nickel bath is detrimental to a good deposit, the writer would be in position to show some very bad specimens of nickel plating.

A nickel sulphate solution of one hundred sixty gallons which has been in use ten months, stands fifteen degrees beaume and has a metal content of five ounces nickel per gallon. The solution is used to plate lamp founts and ventilators of our gasoline lanterns. The cathode is rotated during electrolysis and a current density of thirty amperes per square foot of cathode surface is used. The deposit is very fine grained and easily buffed to a high luster.

The plating machine is equipped with seven spindles and in plating the lantern ventilators three hundred fifty amperes flow through the one hundred sixty gallons of solution almost continuously for nine hours each day. Anodes of 96 to 98% pure nickel dissolve evenly and with very little waste. The sediment in the bottom of the tank has been analyzed at different times and found to contain eight and one quarter per cent nickel.

Each month a sample of the solution is taken and a nickel determination made to find the metal content of the bath. About thirty pounds of nickel sulphate are needed each month to replace the nickel not dissolved from the anodes and that lost by wasted solution. This could be decreased some by keeping the bath slightly acid, but nickel costs no more in salts than in anodes.

A neutral solution with greater current efficiency is preferred to a slightly acid bath with its accompanying evolution of hydrogen to the detriment of the deposit. The bath is kept neutral to secure the greatest current efficiency. Up to the present time more than seventy thousand lamp founts have been plated in this way and about ten pounds of carbonate of nickel have been used. These facts and figures are taken from actual commercial plating and not laboratory experiments. They show to what extent rapid plating can be carried on with single salt solution and the ease with which the solution is kept in good condition.

E. W. HEIL,
Member St. Louis Branch. Wichita, Kansas.

OXIDIZING AND COLORING OF COPPER.

In producing the various shades and colors on copper and copper-plated articles, the most commonly used agent seems to be Potassium Sulphide, which is very often called Liver of Sulphur, or Sulphurite. Any number of shades can be derived by the use of a solution of this chemical. To give definite formulas for the production of the various shades is rather difficult, as the grades of purity of the Potassium Sulphate vary. The amount of the chemical dissolved in the solution plays a very large part and the temperature of the dip has a wonderful influence. In general, when a small amount of Sulphurite is used to a large quantity of water, the colors are not so deep and pronounced. Regarding the temperature, the shades do not form as quickly when the solution is cold and a deep black is hard to obtain in a cold solution. The length of time an article is immersed, also plays a very important part, as the longer the article is immersed the deeper the shade. For the lighter shades of brown a very dilute solution is used and the solution is generally used cold or luke warm. As more of the Sulphate is added, the darker the shades will become. This is also true regarding the time of immersion and the temperature to which the solution is heated. The longer the time of immersion, the darker the shade, and the higher the temperature of the solution the darker the shade. In order to obtain the various shades a little practice and experimenting are necessary. Always bear in mind that there are three factors which control the production of the shades, namely, the concentration of the solution, length of immersion and temperature of the solution. Keep these things in mind and manipulate accordingly.

Another thing which helps bring out the various shades is scratch brushing. One shade is produced by scratch brushing wet and another by scratch brushing dry. Variations of the shade are to be had by using a brass scratch brush and a steel brush. At times there is trouble by getting an uneven shade. Very often this uneven shade will be made even by scratch brushing and immersing again. For producing the brown shades a good deal of judgment is required.

In producing a deep black on copper a good way is to use a solution containing about one-quarter of an ounce of Sulphurite to one gallon of water. Use the solution very hot and allow the black to form slowly. Dry in hot water and scratch brush, dry with a steel brush. The high parts can then be relieved with pumice. If a striped finish is desired, stripe with a small felt wheel. Scratch brushing dry will bring up a dark luster and will harden the oxidize. This hardening of the oxidize will make the relieving somewhat harder as more pressure is necessary in order to remove the oxidize from the high parts. Care must then be taken when relieving articles which have only a light deposit of copper as it is easy to cut through to the base metal.

Trouble is often caused by the oxidize flaking and coming off in a fine powder. When the oxidize flakes off it will show that the

work was not clean or that the dip is too strong or too old. A small amount of ammonia will help to make the oxidize black. Iron chloride (Ferric Chloride) also helps set the color.

Barium Sulphide while not used as extensively as Potassium Sulphide, is also recommended for producing the various brown shades.

SAMUEL R. TAYLOR,
Newark Branch.

SUPREME SOCIETY BUDGET FOR 1915-16 UNDER PRESENT CONDITIONS.

ESTIMATED EXPENSES:

Salaries:

Editor	$ 100.00
Secretary-Treasurer	60.00
Mileage of Supreme Officers (estimated)	125.00
Reporting Annual Convention	60.00
Secretary's office expenses, printing	50.00
Postage and Incidentals	50.00
Cost of printing the Monthly Review and Editor's expense account, for an average of 600 copies	540.00
Miscellaneous	
Cost of printing 1,000 copies of revised Cons. and By-Laws	40.00
Estimated total cost	$1,025.00

ESTIMATE INCOME:

Per Capita Tax, based on an average of 550 members	$ 550.00
700 membership cards at $.02 each	14.00
Application blanks	6.00
700 Cons. and By-Laws at $.07 each	49.00
Charters	4.00
Electros	1.00
Total estimated income	$ 624.00
Receipts	$ 624.00
Disbursements	1,025.00
Loss	$ 391.00

By charging the branch societies $.10 per copy for all Reviews ordered, on a basis of 550 copies ordered monthly, would give an income of $66.00, and figuring the total cost per copy at $.05 each, for 600 copies it would net the society $10.00 per month or $120.00 per year after paying all expenses of publication and would change the deficit of $391.00 to a surplus of $269.00 on the basis of this estimate.

WHAT THE BRANCHES ARE DOING

NEW YORK

Meets fourth Friday of each month at Broadway Central Hotel, Ney York City, 8 p. m. Secretary, Joseph Minges, 148 Schenck Ave., Brooklyn, N. Y.

The regular meeting held on July 25th at 258 Pearl Street. The membership of Wm. Taylor was transfered to Dayton Branch, and of Frank P. Davis to Chicago Branch. The laboratory work has been discontinued till cooler weather.

After regular order of business Prof. Joseph W. Richards of Lehigh University gave an interesting talk on the progress made in electro-chemical analysis and described the method discovered of separating Cobalt from Nickel, and for the separation of Lead from a Nitrate solution, he also told of the progress made in separating copper from low grade ore by the leaching process, as well as other topics of interest to the plater.

PHILADELPHIA

Meets first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Streets. Secretary, Philip Uhl, 2432 North Twenty-ninth Street, Philadelphia, Pa.

BRIDGEPORT

Meets third Friday of each month at the office of the Brass World, 260 John Street, Bridgeport, Conn. Secretary, Nelson Barnard, 858 Howard Ave., Bridgeport, Conn.

The officers of our branch for fiscal year are President, W. G. Stratton; Vice-President, B. F. Kusterer; Secretary-Treasurer, Nelson Barnard; Librarian, J. M. Dunn; Sergeant-at-Arms, Christen Wystzen; Board of Managers, H. de Joannis, T. F. Slattery and Geo. E. Hopkins.

A plan has been adopted for examining applicants who desire to affiliate with this branch. While we have been at ease during the summer months, we intend to take up study of chemistry early in fall. Our efforts in that line were very successful last year.

The amendment to the constitution admitting assistant foreman platers was unanimously endorsed.

NEWARK

Meets first and third Friday of each month, 8 p. m., 47 Bank Street, Newark, N. J. Secretary, Geo. Reuter, Jr., 333 S. 19th Street, Newark, N. J.

CINCINNATI

Meets once each month at Dennison Hotel, Cincinnati, Ohio. Secretary, F. H. Nordmann, 720 Froom Ave., Cincinnati, Ohio.

ROCHESTER

Meets second and fourth Friday of each month at University of Rochester. Secretary, C. V. Haring, 603 Dewey Avenue, Rochester, N. Y.

BUFFALO

Meets first Saturday of each month at the University of Buffalo, 8 p. m. Secretary, John G. Murphy, 71 Dingens Street, Buffalo, N. Y.

CHICAGO

Meets fourth Saturday of each month, 8 p. m., Western Building, Randolph Street and Michigan Avenue. Secretary, H. E. Willmore, 5911 South Boulevard, Chicago, Ill.

The annual "Smoker" of Chicago Branch was held at the Briggs Hotel Saturday evening, July 10th, at which about sixty members and their friends were present. No attempt was made at discussion of plating subjects but a general good time was enjoyed by all. Favors were distributed in the form of pocket volt meters.

The regular monthly meeting was held July 24th with O. E. Servis presiding. A communication was received from New York Branch and read by the secretary, protesting against the amendment to the Constitution allowing the admission of assistant foreman platers in the Society. Upon a vote being taken on the matter, Chicago Branch went on record as being unanimously opposed to their admission.

Owing to the terrible disaster to the "Eastland," which had occurred early in the day, the meeting adjourned at an early hour as the building in which the meetings are held contained over seventy of the victims, fortunately, none of our members were numbered among the dead.

TORONTO

Meets fourth Thursday of each month at Occidental Hall, Bathurst and Queen Streets. Secretary, Ernest Coles, P. O. Box E, Coleman, Ont., Canada.

The June Meeting of the Toronto Branch was held in Occidental Hall, on the 24th. Pres. Magill presiding over a record attendance, who thoroughly enjoyed the evening. The election of officers for the coming year resulted as follows:

President, Wm. J. Salmon; Vice-President, John Acheson; Secretary-Treasurer, E. Coles; Librarian, J. A. Magill; Trustees, W. W. Wells, Jr., Chas. Orr and W. S. Barrows; Sergeant-at-Arms, John Young. Mr. Young in accepting office remarked, "I would sooner be the doorkeeper in the House of the Lord than captain of a band of thieves," which is saying "something" for this branch. The report of the Dayton Convention from the Supreme President proved most interesting and gratifying and was greeted by prolonged hand-clapping. With the Supreme Presidency, the convention and an honory membership in the Supreme Society, our members may

well feel that we have obtained a good share of the "plums" from the past convention. Mr. Barrows in the manner so characteristic was able at this early date to report preliminary arrangements for quarters to hold the business section and exhibition, and outline plans for the 1916 Convention.

Our exuberance may be pardonable, but knowning him as we do, we are convinced that with Walter at the helm and the right support from the members, 1915-1916 will be a banner year for the A. E. S.

Mr. W. J. Wilson of the Technical School elected to the Supreme Society, expressed his appreciation for the same, and stated his desire to be of service to the society at large and to the convention in particular.

Past President Magill in speaking from the chair for the last time reviewed briefly his policy in the past year and expressed his thanks to the members for the support given.

President Salmon also spoke and exhorted the members to cooperate and support him and the branch in even greater manner than in the past. A motion was passed that "any officer absenting from three consecutive meetings or not performing the duties of office in a diligent manner, shall be removed from such office."

A discussion on nickel plating used on radiators successfully and without contamination of the solution, brought a very interesting meeting to a conclusion.

The July meeting of this branch was held on the 24th, with Pres. Salmon presiding over a good attendance, who heartily enjoyed the meeting. Toronto Branch has this year a genuine "live-wire" librarian in Mr. J. A. Magill. A discussion on Copper Solution was called for in the notices of meeting, and armed with various "articles," notes from experiments in the laboratory and a sound practical knowledge, Bro. Magill was able to give a good many points on the subject for discussion. Numerous published formulas conducting salts, brighteners, etc., were discussed, all members enthusiastically taking part and making discussion both profitable and enjoyable. If this meeting which was the first with the new officers and therefore the first in the new year, is to be taken as a standard, a really good year is in store for this branch.

ST. LOUIS

Meets fourth Saturday of each month at Public Library, Assembly Rooms. Secretary, F. C. Rushton, 4405 Blair Avenue, St. Louis, Mo.

The St. Louis Branch held their last meeting at Ebsens Grove, Belleville, Ill., and were royally entertained by the Belleville members. The afternoon was spent in making good use of Mr. Weygant's auto, the grandfathers playing pinochle, and the younger elements went swimming.

In due time the meeting was called to order, and after the regular business session was concluded, Mr. Robins gave a very de-

tailed talk on the advantage of using Single Nickel Salts, instead of Double Nickel Salts, going into the subject very thoroughly. The St. Louis members afterwards declared it was the most enjoyable meeting they had ever had and it was proposed to make the Belleville meeting an annual affair.

Mr. H. Deubelbeis invited the St. Louis Branch to hold their next meeting at his residence at Luxemberg, Mo., and it was agreed to have a baseball match on that occasion, between Single Salts and Double Salts. Mr. Robins declared Single Salts couldn't lose.

DETROIT

Meets first Friday of each month at Prismatic Hall, 140 1st Street. Secretary, B. E. Miller, 543 Townsend Avenue, Detroit, Mich.

The regular meeting of July 2nd was called to order by President A. E. Wetmore in the chair and a good attendance of members.

After the regular order of business a paper was read by E. G. Sovering. Subject: "Acid Copper" and with it some of his work, such as the Declaration of Independence taken from an embossed cardboard, also Lincoln's bust from cardboard and others which were finished up in old copper and bronze.

MILWAUKEE

Meets second Wednesday of each month at Marquette University. Secretary, E. C. Yaeger, 962 9th Street, Milwaukee, Wis.

DAYTON

Meets first Wednesday of each month at the Y. M. C. A., Dayton, Ohio Secretary, Alphonz Lamoureux, 500 East First Street, Dayton, Ohio.

CLEVELAND

Meets second and last Saturday of each month at Central Y. M. C. A. Secretary, Charles Werft, 331 Strathmore Avenue, Cleveland, Ohio.

TOLEDO

Meets every Wednesday at Toledo University. Secretary, James E. Nagle, 209 Navarre Avenue, Toledo, Ohio.

INDIANAPOLIS

Meets last Saturday of each month at Hotel Dennison. Secretary, Artes Nelson, 1617 Shelby Street, Indianapolis, Ind.

Applications for Membership.

DETROIT BRANCH:

Wm. P. Manning.....Jervis House, Syracuse, N. Y.

CHICAGO BRANCH:

V. E. Straner.....231 5th Avenue, Minneapolis, Minn.
B. K. Congdon.....1129 Jones Street, Ft. Wayne, Ind.
A. O. Norberg.....3621 N. Sawyer Avenue, Chicago.
G. A. Johnson.....3744 N. Racine Avenue, Chicago.

Elected to Membership.

INDIANAPOLIS BRANCH:

Jos. E. Loch.....467 Downing Street, Indianapolis, Ind.
Louis Mertz.....925 Chadwick Street, Indianapolis, Ind.

DETROIT BRANCH:

E. W. Woodmansee.....82 Colburn Street, Detroit. Mich.
Anthony J. Fritz.....738 Cadillac Avenue, Detroit, Mich.

ST. LOUIS BRANCH:

G. W. Gilson.....724 Campbell Street, Kansas City, Mo.

BRIDGEPORT BRANCH:

N. Milliebeiun.....792 George Sstrre, New Haven,Conn.

Change of Address.

John Acheson.....1049 Dundas Street, Toronto, Ont.
Jos. Wooldridge.....Leland Hotel, Carleton Place, Toronto, Ont.
E. G. Nordbloom.....1454 West 6th Street, Davenport, Ia.
E. C. Neun.....144 Wreford Avenue, Detroit, Mich.
Frank J. Hanlon.....1109 St. Laurence Avenue, Beloit, W.
W. C. Shaffer.....416 W. 19th Street, Norfolk, Va.
M. S. Herman.....3040 Fulton Street, Chicago, Ill.
M. W. Baldwin.....5339 W. 24th Street, Cicero, Ill.
E. L. Ingram .....2840 Colorado Avenue, Chicago, Ill.
H. G. Binder.....5236 W. 23rd Place, Cicero, Ill.
F. J. Neitzel.....2646 Washington Blvd., Chicago, Ill.
J. E. Younger.....247 State Street, Elgin, Ill.
John Kamrath.....730 E. Third Street, Mishawaka, Ind.
A. A. Nelson.....106 Sherman Street, Hamilton, Ont., Can.

FACTS ABOUT NICKEL SALTS.

FORMULAS.

Double Salt.....$NiSO_4 (NH_4)_2SO_4 .6H_2O$.
Single Salt (ordinary).....$NiSO_4 .7H_2O$

Percentage of Nickel contained in each:

In Double Salts.....14.87%
In Single Salts.....20.91%

(Therefore Single Salts contain 40.6% more Metallic Nickel than Double Salts.)

SOLUBILITIES.

100 pounds (12½ gallons Cold Water will dissolve:
2½ pounds Double Salts 75.6 pounds Single Salt.
100 pounds (12½ gallons) Hot Water will dissolve:
39.2 pounds Double Salt. 475.8 pounds Single Salt.

(The above shows that a much greater quantity of Metallic Nickel can be dissolved for use by means of Single Salts.)

Presented by G. S. Robins, at meeting held at Belleville, July 31, 1915.

BE A FRIEND.

Live your life in friendship's sun
Warm and glowing let it run
Out to other fellows' lives,
Cheer the neighbor here who strives,
Smile on him, and shake his hand,
Let him know and understand,
Skies of gray, or skies of blue,
That he has a friend in you.
Live your life out to the end
Brave and helpful, as a friend;
Do not draw yourself apart
Narrow mind, and selfish heart;
There is much more real fun
Sharing life with every one.
Let who will, if he be true,
Claim a real friend in you.
Live your life in friendship's sun,
Open-hearted, full of fun.
Don't go trudging on alone,
Merely selfish flesh and bone;
Let your heart forever be
Filled with human sympathy;
Share whatever God may send,
That's the way to be a friend.

—Detroit Free Press.